DYNAMICS EXPLORER I SOI IMAGES OF THE "ANTARCTIC OZONE HOLE"

G. M. Keating[1], W. E. Bressette[1], C. Chen[2], M. C. Pitts[2], and J. Craven

[1]Atmospheric Sciences Division, NASA Langley Research Center, Hampton, VA 23665-5225
[2]ST Systems Corporation, Hampton, VA 23666
[3]University of Iowa, Iowa City, IA

The Dynamics Explorer satellite (DEI) carries an Auroral Imaging Package which contains filters designed for performing backscatter ultraviolet measurements to measure total column ozone in the Earth's middle and lower atmosphere. Measurements are obtained at 317.5 mm (to measure ozone absorption) and 360 nm (to measure scene reflectivity). This subset of the Auroral Imager is called the Spin Scan Ozone Imager (SOI). Using the spin of the spacecraft (in conjunction with a scanning mirror), a spin-scan image of the Earth may be obtained every 12 minutes. The apogee of the spacecraft is extraordinarily high (23,000 km) compared, for example, with the Nimbus 7 apogee (955 km), and this allows global scale ozone images to be obtained of the illuminated Earth in just 12 minutes. With the high apogee, both temporal variations at a location can be studied for hours at a time, and synoptic images of larger portions of the ozone field can be obtained than from previous BUV-type measurements.

In October 1985 and 1986, measurements were obtained near apogee of the Antarctic "ozone hole." The only other high spatial resolution measurements were obtained from the Nimbus 7 TOMS experiment. In October 1987, the Dynamics Explorer apogee had precessed into the Northern Hemisphere preventing measurements of the ozone hole. However, measurements should be obtained from DE of the ozone hole in both 1988 and 1989. Considering that the Nimbus 7 TOMS instrument has long exceeded its expected lifetime, the DEI SOI experiment could easily play a crucial role in studies of the ozone hole over the next few years.

Shown in Fig. 1 is a contour chart of the ozone hole obtained from the DE SOI experiment for October 12, 1985. Notice the three-sided configuration of the ozone hole and that the hole is not centered on this day on the Pole. Shown in Fig. 2 is a comparison of the DE SOI measurements with ground-based total column ozone measurements from various Dobson stations. The provisional measurements from Halley Bay are somewhat lower than the extraordinarily low ozone values measured by the DE-SOI experiment. However, the general agreement with the Dobson stations is quite good.

Shown in Fig. 3 are contours of the NMC temperatures at 70 mb for October 12, 1985. At mid-latitudes, it may be seen that generally

maximum temperatures appear near the location of maximum column ozone, and minimum temperatures occur near minimum total ozone. The correspondence of high ozone and high temperature may be partially attributed to subsidence resulting in adiabatic heating and also in convergence of the ozone field.

The Antarctic ozone hole, where lowest temperatures and ozone concentrations occur, is shielded and shaped by the polar vortex, which results in the temperature and ozone contours in the hole having similar shapes. A study of satellite data reveals rapid hourly changes of the evolution of contours of minimum ozone within the ozone hole, suggesting that daily maps do not necessarily represent mean daily conditions of ozone within the hole.

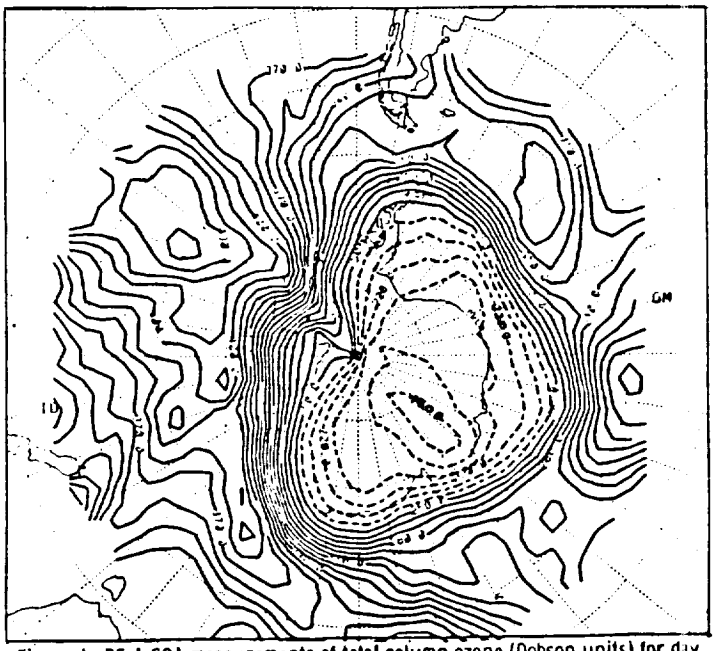

Figure 1. DE-1 SOI measurements of total column ozone (Dobson units) for day 285 of 1985 over the South Pole. The latitude and longitude intervals are 10 degrees and the heavy dashed lines are for contour intervals of less than 250 Dobson units.

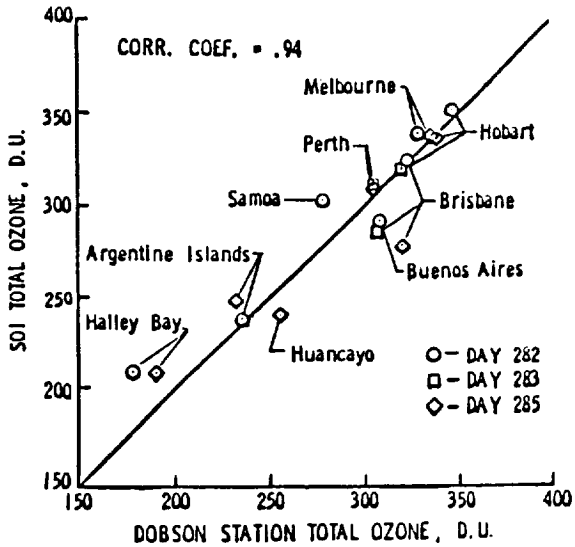

Figure 2. SOI total ozone versus southern hemisphere Dobson ground station total ozone data.

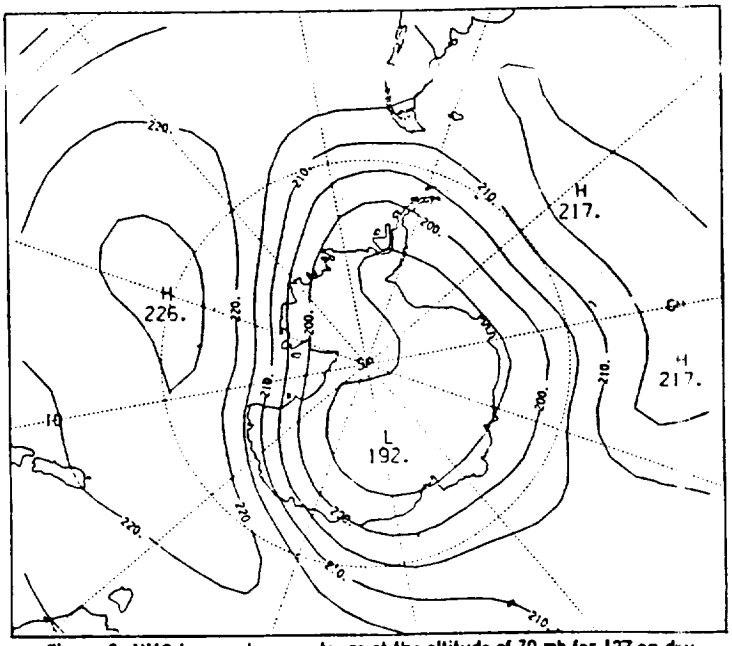

Figure 3. NMC temperature contours at the altitude of 70 mb for 12Z on day 285 of 1985 over the South Pole. Latitude and longitude intervals are 30°.